ture (hitherto assumed to be entirely symmetrical) and other subjects bearing on vegetable anatomy, and the difficulties which brought discredit on phyllotaxy all vanish. Perhaps it may furnish a solution of the problem why wooden poles split in antidromic spirals, for which phenomenon some people have suggested the stress of wind on the living tree.

My work has been necessarily hurried; and I shall be glad if others will verify or amend it, and help to fill the many lacunae which I am compelled to leave unsupplied.

PRINCETON COLLEGE, Sept. 7, 1895.

Description of a new problematical Plant from the Lower Cretaceous of Arkansas.

BY F. H. KNOWLTON.

PALEOHILLIA ARKANSANA gen. et. sp. nov.

Stems hollow, .5–.75 cm. in diameter, several centimetres long, broken; wall two or three layers of cells thick; cells of epidermis of two kinds: 3–5 longitudinal rows of elongated, thin-walled cells that are two or three times longer than wide, alternating with broad bands of shorter and more irregular cells; stomata numerous, confined to the broad bands of irregular cells, arranged in three rows, two next to the rows of elongated cells with a row of distant ones between; stomata with apparently 4–6, usually 5, guardian cells.

The material upon which this description is based was collected by Prof. R. T. Hill, of the United States Geological Survey, during the season of 1888, while engaged under the auspices of the Arkansas Geological Survey in making a general investigation of the geology of southwestern Arkansas. It came from a gulch on one of the smaller branches of the Muddy Fork of Little River, about six miles northeast of Center Point, Howard county. The deposits containing these fossils were referred by Prof. Hill to the Trinity Division of the Lower Cretaceous. The beds are described as consisting of basal ferruginous sands, succeeded by firm white or yellow sand often filled with small concretions of iron pyrites, and mixed with clay. This clay is in sufficient quantity to bind the sandy material together "so that in drying it often becomes

almost as hard as burnt brick." It was in this clayey material that these plant-stems were found.

The stems are very abundant and scattered in all directions through the mass. They appear to have been much rolled about and broken up, it being difficult to find a piece three centimetres in length. They were originally hollow, but most of them are now pressed perfectly flat, although an occasional one is found that was filled with clay when probably in a fresh state and consequently retains nearly its cylindrical form. When liberated by the crumbling of the sandy clay, the stems are very dark brown, almost black, in color and perfectly opaque. By boiling them for a few moments in dilute acid, a large part of the coloring matter was discharged and the cellular structure could then be made out.

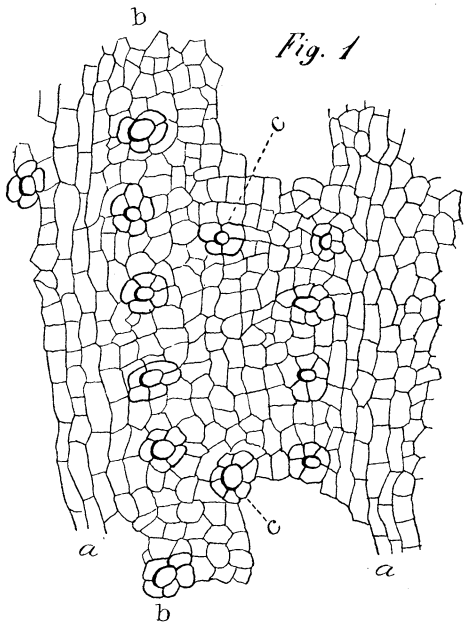

Fig. 1

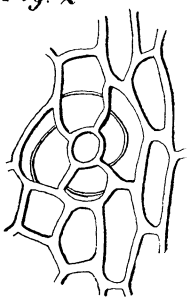

Fig. 2

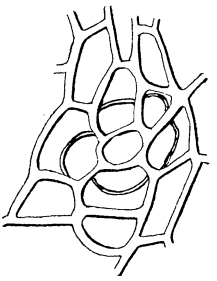

Fig. 3

Fig. 1.—Epidermis of *Paleohillia Arkansana* × 90.
a, a, bands of long, narrow cells.
b, b, bands of short irregular cells, with three longitudinal rows of stomata.
c, c, stomata with four and six guardian cells respectively.
Fig. 2.—Stoma with four guardian cells × 300.
Fig. 3.—Stoma with five guardian cells × 300.

This curious plant, as already stated, was hollow, with the walls consisting of three or four, or possibly more, layers of cells. The epidermal cells are markedly separable into two kinds: first, narrow bands of three or four rows of thin-walled cells which are two to four times longer than broad, separated by broad areas or bands ten or twelve cells wide, of short irregularly quadrangular cells. In figure 1 a, a, represents the bands of narrow cells, and b, b, the short irregular cells. Under the microscope the two kinds of cells divide the surface longitudinally in very clearly mark parallel lines.

The stomata are the most remarkable feature about this plant. As may be seen by the drawing, the guardian cells are quite irregular in shape and appear to vary in number from four to six, the most frequent number being five.* The opening is in all cases large and in some instances appears even larger than either of its guardian cells. It is difficult to see how so large an orifice could be completely closed by them.

The stomata, it will be observed, are confined to the broad bands of irregular cells, and are also arranged in longitudinal rows, those next to the bands of long cells being numerous, while in the central row they are scattered, there being only about one-third as many as in the others. The orifice between the guardian cells is approximately circular. The guardian cells are themselves arranged in a more or less regularly circular manner, their shape depending on the number present. When there are only four they are rectangular with rounded outer sides; when there are five or more they are keystone-shaped, or broadly wedge-shaped.

I am at the present time unable to suggest any satisfactory relationship, either living or fossil, for this anomalous plant. The first thought when seeing the numerous fragmentary stems throughout the clay mass, and finding that they are hollow, is that they belong to *Equisetum*. But on examining large numbers of fragments, not a single joint with the characteristic teeth could be detected, and moreover the stomata are entirely different. It is of course well known that the stomata of living *Equisetum* have two

* In figure 1 the guardian cells appear to be in the same plane as the epidermal cells. They are of course below them, but the lines of the overlying epidermal cells have not been drawn in, so that there may be less confusion in following their outline. Figures 2 and 3, much enlarged views of single stomata, make the real condition plain.

pairs of guardian cells, but they are not all in the same horizontal plane, one pair, the "subsidiary cells," of Strasburger being below the other. The guardian cells are usually ornamented by silicified ridges radiating from the orifice, not a trace of which can be found in the fossil under discussion.

Some of the Bryophytes, notably the liverworts, have stomata with more than two guardian cells, but they are loosely cellular plants quite unlike this hollow-stemmed plant.

In the absence of more specific information as to its affinities, I have decided to describe this plant under a tentative name, recognizing the fact that this provisional name may be changed at any time provided the fossil can be more definitely placed. I had at first given it the name of *Hillia*, but as there is a genus of this name in Rubiaceae, I have called it *Paleohillia*. It commemorates the collector and is not intended to imply relationship with the Rubiaceous genus.

Observations upon some Oklahoma Plants.

By Edgar W. Olive.

The botany of Oklahoma is exceedingly interesting, because this territory is a borderland region between the Gray's Manual and Western Texas Manual regions. Until about five years ago, the plants of this district were but little known to botanists, and the results of recent collections disclose a flora rich in interesting forms. Especially valuable is a "List of Plants collected by C. S. Sheldon and M. A. Carleton in the Indian Territory in 1891," published as a contribution from the National Herbarium in 1892.

The months of July and August, 1893, were spent in and about Payne county, in the very northeast of Oklahoma, about 90 miles south of the Kansas line through the Cherokee strip, and about 150 miles west of Arkansas. This is in lat. 97° W. and is but a few miles south of the parallel bounding on the north Tennessee and North Carolina, so that the collections were made just south